connections, respectively. *Second*, since one is not supposed to be able to explain things known per se in terms of anything more evident, simple natures are supposed to be intuited, not defined: 'For who does not know what motion is?' *Third*, all human knowledge is characterized as distinct recognition of how the simple natures known per se compose the other things. *Fourth*, thus there would be no genuine distinction between 'clear' and 'obscure' knowledge. Not *fifth* but *eighth*, an incomplete remark does not help to temper the increasing overdetermination of knowledge in favor of intuition versus deduction. In conclusion, *the knowable* is divided into *simple propositions* and *questions*, and *questions* are divided into ones *perfectly understood* and others *imperfectly understood. Therefore the question is whether knowledge itself really is – thus an awesome assertion located right in the middle of this rule – a purely intellectual and an utterly indefinable nature so simple that one need only be rational in order to know what it is, for the power and the operations of the natural intelligence do not at all appear to fit this description.*

Part Two, comprising three sections – of which only the first is complete – of four, of five, and of three rules, respectively, proposes to treat of determinate and perfectly understood questions.

Section One, consisting of Rules 13–16, shows how determinate and perfectly understood difficulties are abstracted from subjects as well as how they are reduced to the point where certain sought magnitudes are to be recognized on the basis of their relations to certain given magnitudes.

According to Rule 13, one should, if one wants to understand a question perfectly, abstract it from every superfluous conception, reduce it to its simplest form, and divide it into the smallest possible parts accompanied by an enumeration. *The argument is that it is possible to distinguish between perfectly understood questions, which permit expression in the form of an equation because the data involved are homogeneous, as in mathematics, for example, and imperfectly understood questions, which resist articulation in the shape of an equation because the data involved are heterogeneous, as in physics, for example.* The project is to reduce all *imperfectly understood questions* to *perfectly understood questions*. 'Questions' are defined, in juxtaposition to 'intuitions', as all the things in which the true or the false is found. Not only the queries made by others are counted as questions. And there are various modes of seeking something from something else. One is said to be seeking things from words whenever the difficulty is the obscurity of the language employed, and most philosophical disputes are linguistic. One is said to be seeking causes from effects whenever one is investigating whether something is or what it is. In all questions one is supposed to strive, above all, to understand distinctly what is being sought. For one cannot find what one does not know is being sought. Thus every *question* has *three elements*, to wit, *something unknown*, however perfectly, *something known*, however imperfectly, and *the relation between them*; and there are *two possible errors* with respect to this relation. *First*, one may assume more data and more determinate data than are given. *Second*, one can neglect some condition explicitly or implicitly required for the determination of a question. But there is a significant distinction between understanding and answering a question. There is also a big difference between understanding a question and recognizing its peculiar difficulty. So one is supposed to survey the data of a proposition, by rejecting what is superfluous, by retaining what is necessary, and by remitting what is

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doubtful. *Therefore the question is whether it is possible to reduce all imperfectly understood questions to perfectly understood questions – and, if it is not, then what impact is this going to have on the prospects of the 'mathesis universalis' being sought?*

According to Rule 14, one should, in order that the intellect may grasp a question much more distinctly, reformulate it in terms of the real extension of bodies and present it to the imagination by means of bare figures. *The argument is that by representing certain questions pictorially to the imagination one can help the intellect to apprehend them better intuitively*. To begin with, *deducing* the unknown from the known means *discovering* some new entity or *uncovering* the participation of the sought in the given. All knowledge – except for that which is obtained through the simple intuition of a single thing – is gathered through *a comparison of two or more things*. In 'simple and straightforward' comparisons the given and the sought participate in a common nature *equally*; in all others they do so *proportionally*; the task is to derive an equality from the proportions. But only what admits of more and of less can be thus reduced, and this all falls under the rubric 'magnitude' or 'magnitudes in general', that is, magnitudes abstracted from all subject-matter. One has to note that there is a distinction between *magnitudes in general* and *species of magnitudes* as well as that what applies to the former also does to the latter. That species of magnitude which is most distinctly and easily imagined is *the real extension of a body, regarded only in so far as it is shaped*, since nowhere else are the differences of the proportions more distinctly exhibited or the equalities in the proportions more easily developed. A key remark seeks to set priorities: First, ordinary mathematics serves method; then, method and *mathesis universalis* support each other; finally, both method and *mathesis universalis* assist *sapientia universalis*. Meanwhile, 'extension' is defined, not as something other than the extended subject itself, but as all that which has *length*, *breadth*, and *depth*. There are also said to be *three different manners of speaking about extension*. *First*, to say that 'extension occupies a place' is to risk holding extension for something other than that which is extended. *Second*, to say that 'body possesses extension' is to risk thinking that extension contains something distinct from that which is extended. *Third*, to say that 'extension is not body' is to risk falling into the contradiction that the same thing is simultaneously body and not body. Only close cooperation between the intellect and the imagination can prevent these conceptual and linguistic confusions. The failure of the intellect to rely on the assistance of the imagination leads to *fallacies of misplaced abstractness* in arithmetic and in geometry. Now, regarding the extension itself of something extended, every question is supposed to have been reduced to such determinacy that one is to find *an unknown extension* from *a known extension* via a comparison both of the differences between and of the equalities in the proportions between all the relevant features of extension, namely, *dimension*, *unity*, and *shape*. 'Dimension' is defined as a mode with respect to which and as an aspect in accordance with which a subject is considered to be measurable, including not only *length*, *breadth*, and *depth*, but also *weight*, *speed*, and *an infinite number of others*; the very division of a whole into several equal parts is the dimension in terms of which the whole is measured or the parts are counted. There are an infinite number of different dimensions within the same subject, which, whether real or conceptual, have the same function. The line, the surface, and the solid are not three really distinct species of

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geometrical quantity, and length, breadth, and depth are not three really distinct dimensions of body. 'Unity' is defined as the common nature in which all comparanda must equally participate, and *the unit* is *a magnitude* or *a common measure*. Of the many different kinds of figures, two, those by means of which the differences of relations or of proportions are best expressed, are used to display *sets* and *magnitudes*, the two kinds of comparanda. All relations between entities of the same kind are placed either under *order* or under *measure*. *In measuring* comparanda, one needs a *unit* as the common measure; *in ordering* them, one does *not*. But, looking at measures, one can use an assumed unit to reduce continuous magnitudes to a set of units, which can then be arranged in such an order that the knowledge of a measure ensues by means of an inspection of the order. In doing so, one should focus on *length* and on *breadth*, since no other dimensions of a continuous magnitude are conceived more distinctly. Thus *rectilinear and rectangular surfaces* or *straight lines* are described as the simplest figures for displaying continuous magnitudes or a set or a number. *Therefore the question is, not so much whether, but rather how as well as to what extent, one can, when engaged in solving mathematical problems, use the concrete evidence provided by the imagination to improve the abstract evidence achieved by the intellect.*

According to Rule 15, in most cases one should, in order more easily to hold one's thought attentive, draw the pertinent figures and display them to the senses. *The argument is that by representing certain questions figuratively to the senses one can help the intellect to apprehend them better intuitively.* There are said to be *three ways of depicting the unit*, namely, by means of a *square*, if it is regarded only as having length and breadth, or by means of a *line*, if it is regarded only as having length, or by means of a *point*, if it is regarded only as making up a set. *Therefore the question is how the intuitive representation of figures to the senses can best assist the intellect in the search for truth in mathematics.*

According to Rule 16, one should, in order to spare the memory, use concise symbols rather than complete figures to represent those things which, although they are necessary for the conclusion, do not require the present attention of the mind. *The argument is that by representing certain questions symbolically for the memory one can help the intellect to apprehend them better intuitively.* Because *memory* is often shaky, the art of *writing* must assist in the symbolic representation of those dimensions which must be taken into account but cannot be constantly retained. The magnitudes should be expressed by means of as concise and precise symbols as possible, so that a continuous movement of thought can intuit as many as swiftly and as simultaneously as possible. *First*, in order to distinguish best, one abstracts from both geometrical figures and arithmetical numbers in favor of the letters *a*, *b*, *c*, et cetera, for known magnitudes, and A, B, C, et cetera, for unknown magnitudes. *Second*, the root, the square, the cube, et cetera, are redefined in terms of relations as magnitudes in continued proportion preceded by the assumed unit. *Third*, it is noted that, because numbers can express both order and measure, it may happen that a difficulty can be resolved more simply in the given numbers than via abstraction of its terms from them. It is recommended generally that one not remember anything that one can record in writing, so as not to distract the natural intelligence from present concentration by superfluous recollection. These last four rules are also supposed to play a major role in the third part of the treatise. *Therefore the*

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question is how the symbolic representation of figures for the memory can best assist the intellect in the search for truth in mathematics.

Section Two, consisting of Rules 17–21, shows how to handle determinate and perfectly understood difficulties in such a way that, however many unknown magnitudes occur in one proposition, all can be mutually subordinated in terms of proportional relations to a unit and in regard to a sum equal to some known magnitude.

According to Rule 17, one should run through the proposed difficulty directly, and one should do this by abstracting from the fact that some of its terms are known and others are unknown, and by intuiting, through sound discursive reasoning, the mutual dependence of individual terms. *The focus is on the distinction between the direct and the indirect deduction of propositions, and it is shifting from the former to the latter.* The key is to subordinate the many unknown magnitudes in a proposition mutually in terms of a unit, in order to get them to yield a sum equal to some known magnitude. The idea is that, since in the deductive resolution of a question the unknown terms are determined by the known terms, one supposes the former to be the latter, thus using both the direct or intuitive procedure and the indirect or deductive approach, so that the hard, for example, getting from 3 and 48 to 12, becomes the easy, for example, going from 3 and 6 to 12. *Therefore the question is whether and to what extent this is yet another attempt to show how direct, intuitive thinking supports indirect, deductive reasoning – the double-edged effect of which efforts has been quasi to undermine the autonomy of deduction.*

According to Rule 18, one should, for the present purposes, use only addition, subtraction, multiplication, and division – operations by means of which some magnitudes are deduced from others. *The focus is on the definition of algebraic operations and on their figurative representation by means of geometrical formations.* The starting-point is that 'operationes non sunt multiplicandae praeter necessitatem'. In operations in which sought magnitudes are contained in given magnitudes, one finds a magnitude by having the parts that compose it (*addition*) or by possessing the whole and the excess of the whole over the part (*subtraction*); in operations in which this is not the case, one pursues the relation between sought and given magnitudes directly (*multiplication*) or indirectly (*division*). The unit is the foundation of all relations, although the given and the sought magnitudes occupy different positions in each operation. Examples of multiplication are given. Examples of division are given. The stated goal is the explanation of the four operations via the representation of them to the imagination and to the senses. Now the algebraic operations are represented by means of geometrical figures. But there is no claim that this treatment is exhaustive. There is also the preparation of the terms of the other operations. And some figures can be transformed into others and vice versa. Finally, the striving for completeness leads to a need to explain that which needs no explanation. *Therefore the question concerns the architectonic argument of the treatise, and this indicates that the firmament over the work is about to crack.*

According to Rule 19, one should, by means of this method of reasoning, seek as many magnitudes expressed in two different ways as one supposes unknown terms as known for running through the difficulty directly, so that one thus obtains as many comparisons between two equal terms. The elucidation of this rule remains a desideratum.

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According to Rule 20, one should, once the equations have been found, execute the operations multiplication and division, never using the former when the latter is appropriate. The elucidation of this rule also remains a desideratum.

According to Rule 21, one should, if there are many equations of the pertinent sort, reduce them to a single one, namely, to that equation whose terms occupy fewer places in the series of magnitudes in continued proportion, according to which series the terms are to be arranged in order. The elucidation of this rule remains yet another desideratum.

Section Three, consisting of Rules 22–24, is completely missing and thus it is hard to determine its specific structure or concrete content.

Part Three, which would have comprised Rules 25–36, would have treated of imperfectly understood questions. But this part lacks, once again, all its rules. Indeed, the attempt to reduce imperfectly understood questions to perfectly understood questions would no doubt have met with fierce resistance from the concrete, heterogeneous, material cores of at least some of the empirical-scientific problems at issue.

So could Descartes have ever achieved, in a single discipline, both the *consistency* of formal mathematics and the *completeness* of universal ontology? While he would have needed both the one and the other for a genuine *mathesis universalis*, there are no indications in the *Regulæ* that Descartes thinks that this discipline could encompass *everything without further ado*. After all, Descartes never denies that there are things which cannot be understood in terms of order and measure. Indeed, for all his irresistible attraction to the mathematical ideal of evidence and of certainty, Descartes does believe that there are things which, although they cannot be quantified, can be apprehended in the highest degrees of clarity and distinctness – or that what can be measured in quantitative units and what can be grasped in rigorous concepts do not coincide. Of course, none of this changes the fact that the *mathesis universalis* developed in the *Regulæ* does not even include all the things that can be apprehended in terms of order and measure. Thus the reader is looking at an unfinished project which, even if it had been completed, would still have been rather limited.

Yet, all things considered, and despite the fact that this project remains essentially a fragment, in the *Regulæ* Descartes still achieves an intensity of concentration on a single issue which is hardly superseded in any of his other works. It is the problem of *evidence*. For the main aim of this work is to develop a methodology for rendering evidence in general as present, as graphic, and as reliable as possible, that is, as present, as graphic, and as reliable as mathematical evidence in particular – thus, at least, the argument. Therein also lies a special connection between the given *methodus* and the sought *mathesis universalis*. Still, whereas mathematics emphasizes a superstructure of abstract, formal, and deductive reasoning, methodology stresses the corresponding infrastructure of concrete, material, and intuitive experience – as the teleology of the work right up to and beyond the final extant rules shows. Therefore *methodus* and *mathesis* are supposed both to learn from and to teach each other mutually in certain respects. In no case, in other words, would it be accurate to depict the Descartes of the *Regulæ* as unreflectively striving to recreate all science in the image and likeness of mathematics. Rather, Descartes wants to eat his cake and to have it too, that is, he argues for a method which

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